

Application No. 10/671,358
Amendment Dated 10/12/2005
Reply to Office Action of May 26, 2005

AMENDMENTS TO THE DRAWINGS

The attached sheet of drawings in the Appendix includes changes to FIG. 1. This sheet, which includes FIGS. 1 and 2, replaces the original sheet including FIGS. 1 and 2.

In FIG. 1, the legend "Prior Art" is added beneath the legend "FIG. 1."

Attachment: Appendix: Replacement Sheet 1 of drawing.

REMARKS/ARGUMENTS

By this Amendment, claim 1 is amended. Claims 10-14 were withdrawn from consideration pursuant to a restriction requirement. Claims 1-15 are pending.

Favorable reconsideration is respectfully requested in view of the foregoing amendments and the following remarks.

IN THE DRAWINGS:

The Examiner stated that FIG. 1 should be labeled as "Prior Art." By the present Amendment, applicant has amended FIG. 1 accordingly.

RESTRICTION/ELECTION:

Applicant hereby affirms his prior election of claims 1 to 9 and 15, reserving his rights under 35 USC § 121 to file a divisional application for the nonelected claims.

**SUMMARY OF THE INVENTIVE FEATURES OF
THE PRESENT INVENTION, AS CLAIMED:**

First, claim 1 is amended to clarify that which the inventor believes to be his invention and to better relate the claim to the subject matter in the specification. The words "comprising a" have been moved such that the preamble now properly reads: "An aircraft brake heat pack brake disc in the form of a composite article, comprising a...."

It is an object of the current invention to provide a brake disk which allows for a heat pack to be formed which has a lower overall length while having a similar (or lower) weight but

which has the same or improved wear rate. This enables the weight of the associated brake components to be reduced, thereby ensuring a lower overall weight of the brake and wheel assembly. This is achieved by providing a relatively higher density core to which is attached a pair of relatively lower density wear faces. This may be achieved by providing a silicon infiltrated C-C core and C-C wear faces.

It is necessary to have a certain mass of material in a heat pack to absorb the heat generated during braking. As stated in the application at page 2, lines 19 to 21, it is known to provide silicon infiltrated wear faces. Such wear faces improve friction characteristics but exhibit higher wear rates than C-C wear materials. Previously, silicon infiltration of wear faces has been used to provide better friction performance knowing that wear will be higher – resulting in a larger disc, or a disc which must be replaced more frequently. Both of which are deleterious.

It will further be appreciated that the disc of the invention comprises core and wear layers which are typically distinct components which are joined together to form a composite article, rather than a unitary structure which is formed in a single operation. The language used makes this abundantly clear to the skilled addressee.

REJECTION UNDER 35 U.S.C. § 102:

The Examiner first rejected claims 1, 3 and 15 under 35 U.S.C. 102(b) as being anticipated by U.S. Patent No. 6,174,594 (Smith et al.) for the reasons set forth in the British Search Report. The British Search report states that that the invention lacks novelty or inventive

step. With respect to the Examiner's statement "for the reasons set forth in the British Search Report," applicant is not clear precisely what the Examiner means. All the British Search Report states is that the invention lacks novelty or inventive step. A British Search Report is, by its nature, a non-binding preliminary opinion of one examiner and need not reflect the substantive objections, which are to be raised at a later date. It is the task of the search examiner to collate evidence which may be useful during substantive examination. Consequently, there are no specific objections or rejections contained in the Search Report and no corresponding reasons for the objections or rejections. If the Examiner is not convinced to allow the present claims, as amended, it is requested that the Examiner state specifically his reasons for the rejection such that the applicant can adequately respond.

Smith et al. disclose a method of making a preform by laying up a plurality of layers and introducing consolidating fibers, by needling. These fibers extend across the layers, and ensure that the so-formed preform is easier to handle than those made using prior art methods. The so-formed preform has a density which is higher at the top and bottom layers than in the central region (see col.8 at lines 34 to 38). It is the top and bottom faces which provide the wear layer in the finished product (see col. 8, lines 30-31).

It is acknowledged in Smith that because the preform (and hence the finished article) is stronger than previous articles (see col, 16, lines 65-67), it is possible to reduce the overall density of the preform compared with the prior art (see col. 17 at lines 2-10). While such a formed disc would provide savings in material costs (as acknowledged in Smith at col. 17, lines 1-2), it would also necessarily lead to discs having a larger volume to ensure that the heat pack

mass is maintained to provide an adequate heat sink. This would lead to the associated components of the brake in an aircraft (torque tube, brake chassis and so on) being larger and therefore heavier.

Clearly, rather than anticipating the subject matter of claim 1, Smith et al. actually teach away from the claimed subject matter. In particular, Smith et al. do not teach a disc having a core with wear layers attached thereto but rather to a unitary disc structure in which the outer layers have a density higher than the inner layer.

As explained above, such a structure would not result in the advantage of the present invention, namely that the overall weight and/or size of the brake components can be reduced while the wear characteristics are not antagonized.

Moreover, there is no disclosure in Smith et al. of a core layer having a density of more than 1.85 gcm^{-3} . Indeed, and as stated above, the density of the preform of Smith et al. is reduced compared with prior art structures.

The maximum density which can be achieved in a C-C disc (as per the teaching of Smith et al.) is 1.85 gcm^{-3} . Therefore, the requirement of claim 15 cannot be met and there can be no anticipation of the subject matter of claim 15 by Smith et al.

It is therefore respectfully requested that the Examiner withdraw the rejection under 35 U.S.C. § 102 and pass claims 1, 3 and 15 to allowance.

The Examiner then rejected claims 1, 2, 3, and 15 under 35 U.S.C. § 102(b) as being anticipated by U.K. Patent No. GB 2298687 (Fennell et al.) or U.S. Patent No. 6,057,022 (Purdy et al.) for the reasons set forth in the British Search Report. Again, the British Search report

states that that the invention lacks novelty or inventive step, but the Examiner does not list specific reasons. Again, if the Examiner is not convinced to allow the present claims, as amended, it is requested that the Examiner state specifically his reasons for the rejection such that the applicant can adequately respond.

GB 2298687 (Fennell) discloses a brake disc which has a friction region which has "... a homogeneous structure...." (see page 10, line 17) and a composite structure with a drive region having a lower overall density than in that of the friction region (see page 10, lines 12-21).

As will be appreciated from, *inter alia*, Example 1 of Fennell, the disc is made by laying up a plurality of segments. Each segment was cut from the same cloth. The result of such a construction is that the core has an identical density to the friction region (or, in the language of the present invention, the wear layer).

Clearly, the core and the wear layers must have identical densities. Therefore, there can be no anticipation of the claims of the current invention by the Fennell patent.

Purdy et al. also do not teach subject matter which anticipates the claims of the present invention. Purdy et al. disclose a method of providing a density gradient through the thickness of a composite article. In FIG. 8, there is shown a densified structure wherein the core is denser than the top (as shown) face. However, such a structure is unacceptable for brake applications, as Purdy admits (see col. 8, lines 39-40). Indeed, Purdy et al. further accept that in a unified structure, the density gradient must be symmetrical for braking applications (see line 63-64 of col. 8).

The structure of FIG. 9 shows a densified structure having outer layers (indicated at 312)

which are denser than the core (indicated at 316). This is in contradistinction to claim 1 of the application in suit where the outer layers (the wear layers) have a density lower than the core.

All of the teachings of Purdy et al. are related to the increased densification of the outer layers compared to the core or the densification of the inner and outer peripheries (where the drive slots are formed). There is no teaching of having relatively low density wear faces and a relatively high density core. Furthermore, there is no indication that the benefits of the invention in suit can be obtained.

In the circumstances, Purdy et al. do not anticipate the subject matter of current claim 1 or claim 15.

REJECTION UNDER 35 U.S.C. § 103:

The Examiner next rejected claims 1-9 and 15 under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,042,935 (Krenkel et al.) or U.S. Patent Publication No. 2003/0057040 (Bauer et al.) or U.S. Patent No. 6,221,475 (Domergue et al.) or U.S. Patent Publication No. 2002/0068164 (Martin) in view of the '687 Fennel et al. patent or the '022 Purdy patent or U.S. Patent No. 6,079,525 (Dietrich et al.). The Examiner states that it would have been obvious at the time the invention was made to select the density of the core to wear layer in each of the principal references to be with the core density 1.95 gcm^{-3} to 2.95 gcm^{-3} and the wear layer(s) 1.95 gcm^{-3} or lower as taught by each of the secondary references to reduce weight and costs to compensate for the squeezed profit margins in businesses today by routine trial and error which leads to optimum ranges without sacrificing the brake's ability to operate within acceptable wear frames and weight and heat concerns.

Krenkel et al. disclose a brake disc for an aircraft which has a core to which is secured wear faces. The wear faces are formed of carbon fiber infiltrated with silicon carbide and silicon. As stated in the current application, silicon and silicon carbide are of greater density than carbon. Consequently, the core disclosed in Krenkel et al. can only be of equal or lower density than the wear faces. This teaches in the opposite direction to the current invention, as claimed in independent claim 1. Therefore, Krenkel, alone or in combination with the Fennel et al. patent or the Purdy patent or the Dietrich patent do not teach the present invention, as claimed.

It is noted that Dietrich discloses the use of silicon to infiltrate a C-C preform. There is no disclosure of infiltrating a core with silicon and applying a C-C wear face thereto. Indeed, Dietrich is concerned with the manufacture of a brake couple comprising a disc and a lining (such as would be found in a motor vehicle) rather than an aircraft brake heat pack. It is therefore respectfully requested that the Examiner pass claims 1-9 and 15 to allowance.

U.S. Publication No. 2003/0057040 (Bauer) discloses a friction or wear layer comprising carbon infiltrated with silicon (see paragraph 0011). Again, Bauer teaches away from the current invention.

U.S. Patent No. 6,221,475 (Domergue) also discloses a disc having a silicon infiltrated friction face (see col. 2, lines 15-24).

U.S. Publication No. 2002/0068164 (Martin), paragraph 0021, discloses that the core and the friction layers are made from the same material, and, therefore, have similar densities.

The Examiner then rejected claims 1-9 and 15 under 35 U.S.C. § 103 as being

unpatentable over the prior art statements or admissions set forth in the instant specification and FIG. 1 in view of GB 2298687 (Fennell et al.) or the '022 patent (Purdy) or the '515 patent (Dietrich et al.). The Examiner states that the difference between the prior art and the instant claims, in summary, appears to be selecting the density of the wear layer to be less than the density of the core which is taught by Fennell et al. and Purdy et al. with the references further teaching the specific ranges. The Examiner states that it would have been obvious to modify the admitted prior art to select the core layer to have a greater density than the wear layer with the specific range taught by Fennell et al. or Purdy or Dietrich et al. in order to reduce costs and it would have been obvious to manipulate the ratios of density, lengths, sizes, etc. as taught by the secondary references and, in the alternative, to select the specific ranges through routine trial and error during routine experimentation to select the optimum ranges to arrive at the best and most cost effective solution to promote strength, good wear capabilities, good heat reduction and weight concerns.

For all of the reasons set forth above with respect to the rejection under 35 U.S.C. §§ 102 and 103, Fennell et al. and Purdy et al. do not teach selecting the density of the wear layer to be less than the density of the core. It is respectfully requested that the Examiner pass claims 1-9 and 15 to allowance.

Finally, the Examiner stated that it is unclear why claim 15 is presented for examination due to its undue breadth and its lack of material details and clear patentability. For the reasons set forth above, applicant asserts that claim 15 is clearly patentable.

Accordingly, it can be seen that none of the primary references relied upon by the

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Examiner leads a person of ordinary skill in the art to the subject matter of the independent claims. In fact, the citations relied upon lead the skilled person away from the heart of the invention, as claimed.

None of the other documents identified by the Examiner remedy the deficiencies of the primary references.

It is respectfully submitted that none of the prior art of record, alone or in combination, anticipates or suggests the invention, as claimed.

For at least the reasons set forth above, it is respectfully submitted that the above-identified application is in condition for allowance. Favorable reconsideration and prompt allowance of the claims are respectfully requested.

Should the Examiner believe that anything further is desirable in order to place the application in even better condition for allowance, the Examiner is invited to contact Applicant's undersigned attorney at the telephone number listed below.

Respectfully submitted,

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Please charge or credit our
Account No. 03-0075 as necessary
to effect entry and/or ensure
consideration of this submission.

Enclosure: One Sheet Replacement Drawing
Two Month Petition for Extension of Time